

Ultrasonographic Investigations of Bovine Cardiac Lesions

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Abstract

In this paper the role of B mode real time diagnostic ultrasonography, both with and without Doppler and colour flow mapping facilities, in the investigation of bovine cardiac disease is discussed. Its uses are illustrated in a number ($n = 18$) of clinical cases. The examination technique is explained along with the equipment and the success of the simplistic approach of B mode echocardiography, which is compared with the application of Doppler vascular flow analysis and colour flow mapping. Conditions such as pericarditis, endocarditis and some congenital defects can be interrogated satisfactorily with B mode but smaller valvular lesions and complex congenital anomalies require Doppler techniques. In the future, the use of echocontrast agents may permit the investigation of these latter problems with simple equipment in the *in vivo* application of such a contrast agent is illustrated.

Introduction

Real time B mode diagnostic ultrasonography is becoming increasingly available to the consulting clinician as its use in the domesticated species expands. To date its application in cattle has been largely reported in reproductive investigations, but with the improvements in scanner technology its use in interrogating the organs of the body cavities in the larger species is becoming more realistic. There has been a reluctance to use B mode in looking at cardiac disease in cattle due to the presumption that more sophisticated Doppler vascular analysis is required for a diagnosis. In effect, many cases of pathology of the pericardium and cardiac valves can be detected with B mode alone as well as the more gross cases of septal defects.

The purpose of this paper is to illustrate the techniques used to investigate a series of bovine cases with cardiac pathology, including the use of Doppler colour flow mapping and echocontrast agents, and outline the success rate for each technique in dealing with the various conditions.

Materials and Methods

The cattle used in the series were referrals from the cattle medicine teaching unit and ranged in age from 2 weeks to 8 years of age, and were drawn from a number of breeds with no sex predilection. The criteria for inclusion in the series was the presence of abnormal heart sounds on auscultation with accompanying signs of cardiac dysfunction. The cattle were euthanised when the clinical condition was considered too advanced for satisfactory recovery or uneconomical for treatment and post mortem examinations were carried out.

The scanner used for the procedures was an Interspec Apogee phased annular array unit (ATL UK Ltd., Letchworth, Herts, UK) which was equipped with a 3.5MHz mechanical sector transducer. The transducer could be driven down to 2MHz to improve penetration in larger animals. In cattle under 8 months of age it was used at 3.5MHz but lowered to 2MHz in animals over this age. Scan information was gathered on super VHS video tape and hard copy retrieved using a thermal copier (Sony UP3000P Sony Corp., Japan).

In preparation for ultrasonographic examination, the animals were clipped in the left and right parasternal areas from the sternum to the costochondral junctions between the 3rd and 6th intercostal spaces. Transmission coupling gel was liberally applied to these areas prior to examination to allow good, thorough transmission of sound. The animals were examined conscious,

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in the standing position, with their thoracic limb drawn forward during examination. The right parasternal window was interrogated first to produce heart images in both short and long axis before turning to the left side to repeat the process. Where gross pathology was revealed ultrasonographically, the lesions were recorded as still images and measurements taken using the electronic callipers. In cases where there was deviation in normal haemodynamic flow patterns, the cardiac chambers and valves were investigated using colour flow mapping and Doppler vascular flow analysis was carried out. Where it was elected to administer an echocontrast agent, this was delivered through an intravenous catheter placed in the jugular vein. The agent was administered only once in any one individual animal. The agent used contained albumen derived air filled microspheres of 200 mm shell thickness and 5 μ diameter. It was administered as an IV bolus in concentrations of $12 \times 10^7/\text{ml}$ with sterile saline as the diluent (Andaris, Notts, UK). Once injected, the material was strongly echogenic when viewed with B mode ultrasound and had the ability to cross the pulmonary barrier plus enhance Doppler signals.

The purpose of the post mortem examinations was to reveal the gross pathology of the thoracic cavity. Once the heart was removed, its chambers were washed out before being immersed in a weak formaldehyde (2%) solution for 24 hours. The hearts were subsequently sectioned in long axis to mimic the scan planes that had been previously achieved and were photographed to match up with the thermal prints of the scan images.

Results

The cases were divided into four categories depending on the clinical and post mortem diagnosis; pericardial effusions, valvular endocarditis, chamber enlargement and congenital anomalies. From these groups six individuals were selected to represent typical ultrasonographic findings and these are discussed as individual reports.

Pericardial Effusion. This was a 3 week old calf which had muffled heart sounds and tachycardia. Scanning from the right parasternal window produced short and long axis images which revealed echogenic material present within the non-echogenic liquor (fluid) of the pericardial sac. This material generated hyperechoic images with irregular outlines and there were flow phenomena as the heart moved within the sac. A characteristic feature of this type of lesion was the presence of highly echogenic diffuse mobile spots which were indicative of gaseous production within the pericardial liquor due to bacterial activity. At post mortem, the pericardial sac was distended with foul smelling fluid which contained organised purulent strands of tissue debris.

Valvular Endocarditis. This group was represented by three cases:

(i) A 4 year old cow presented with a systolic murmur which was loudest on the left. The long axis scan from the left parasternal window revealed an echogenic mass which was located adjacent to the mitral valve but protruded into the left ventricular outflow tract. With colour flow, turbulence was demonstrated at the mitral valve and into the outflow tract. At post mortem there was a vegetative lesion on the edge of the mitral valve cusp and encroaching into the outflow tract of the aortic valve area.

(ii) A 5 year old cow presented with a systolic murmur, loudest on the right side. The long axis scan from the left parasternal window revealed an echogenic lesion adherent to the valvular edge of the tricuspid septal valve cusp. This was imaged as an hyperechoic structure which moved with the valvular excursions. With colour flow there was obvious evidence of turbulent flow through the valve orifice. At post mortem a substantial vegetative growth was found on the septal cusp of the tricuspid valve.

(iii) A 6 year old cow presented with a systolic murmur, loudest on the left side. The long axis scan from the left parasternal window produced an image of the mitral valve area on which there were indications of an hyperechoic edge to the free wall valvular cusp but with B mode, it was difficult to be positive about the extent of the lesion when viewing in real time. Colour flow did produce a positive indication of turbulent flow through the valve orifice indicating valvular incompetence and regurgitation. Post mortem examination produced evidence of bead like vegetative growths along the cusp edge.

Congenital Anomalies. This group was represented by three cases:

(i) An 8 month old calf presented with a systolic murmur which was obvious on both sides but loudest on the right. Scanning from the right and left parasternal windows with B mode failed to detect any underlying pathology, but when colour flow was switched on in the right side window, there was revealed a left to right shunting of blood through a ventricular septal defect (VSD). Post mortem examination showed an VSD of 0.75cm close to the tricuspid valve.

(ii) A 2 week old calf presented with a pansystolic murmur audible on both left and right. The long axis scan taken from the right parasternal window revealed a deficiency in the continuity of the intraventricular septal wall in the close proximity of the aortic valve. When colour flow was applied there was obvious shunting of blood flow right to left. When the interatrial septal wall was imaged from the right parasternal window, a defect was detected in its continuity. Upon colour flow investigation, there was interchange of blood between

the two chambers. Post mortem examination revealed the presence of both an atrial septal defect (ASD) and a VSD.

(iii) A 4 month old calf presented with a systolic murmur, audible on both sides. On imaging from the left and right side there was a failure to identify an underlying cause but there was indication of gross distention of the left atrium. Colour flow produced bizarre turbulence in both the right and left chambers of the heart, which proved impossible to interpret haemodynamically. At post mortem the calf was found to have a VSD plus a communication of the aorta with the right ventricle.

Echocontrast Agents. The agent, when injected into the calf with a suspected VSD, permitted B mode imaging of the agent passing through the septal defect without resorting to colour flow investigation. Similarly in a calf where there had been failure to detect an ASD using B mode alone, an exchange of the echocontrast agent through the atrial wall was indicated by the flow of hyperechoic particles between the chambers.

Discussion

The application of B mode real time ultrasound in the diagnosis of cardiac disorders proved successful with

certain groups of conditions. With pericardial effusion, the echogenic material present within the non-echogenic pericardial liquor made detection simple and correlated well with post mortem findings. The advantage in this form of diagnosis was an ability to evaluate the severity of the condition and thus formulate a better prognosis. The diagnosis of valvular endocarditis cases proved possible when B mode imaging of the lesions were substantial and had sufficient echogenic definition. There was good correlation in detail and size of the lesion. However, when there was only marginal change it required Doppler and colour flow capability for a conclusive diagnosis. Chamber enlargement was detectable with B mode alone as were major septal defects, but with more minor deficiencies in septal walls the use of Doppler technology was required. However, even its use in the face of complex anomalies requires considerable skills in interpretation. The possible use of echocontrast agents in the future could offer a compromise to the investigating clinician where congenital anomalies could be identified using lower cost equipment with only B mode capabilities, and not requiring specialist knowledge of Doppler interpretation.

Abstract

Evaluation of prostaglandin F_{2α} treatment in dairy cows at risk for low fertility after parturition

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The effect of two prostaglandin F_{2α} (PGF_{2α}) treatment protocols on reproductive performance of dairy cows at risk for low fertility after parturition was evaluated. Compared with single treatment of PGF_{2α} 17 to 24 days after parturition, there is no added benefit of 3 treatments with PGF_{2α} at approximately weekly intervals (3 to 10, 10 to 17, and 17 to 24 days after parturition) in cows at risk for low fertility. In addition, vari-

ous medical conditions in cows that have adverse effects on fertility were evaluated as criteria for fertility treatment. Cows with twins had significantly lower pregnancy rates, compared with cows without risk factors for low fertility. Although not significant, cows with retained placentas and assisted calvings had lower pregnancy rates, compared with cows without risk factors for low fertility.